

## Effect of home-based mirror therapy on lower limb function in patients with stroke: A randomized controlled trial

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### Abstract

Stroke is a global health-care problem that is common, serious, and disabling. The rehabilitation of impaired lower limb functioning post stroke is a major issue and approximately 30% of patients with chronic stroke have persistent difficulties in independent ambulation. Hence this study was performed with the objective of assessing the efficacy of Mirror Therapy on lower limb function in patients with stroke as a home based program. 30 subjects meeting the inclusion criteria were selected and divided into conventional therapy (CT group) (n=15) and Mirror + conventional therapy (MT+CT) group (n=15). Fugl Meyer lower extremity score was assessed at baseline. Both the study groups performed conventional treatment for approximately 40 minutes/ day, 6 days/week for a period of 4 weeks. In addition to conventional treatment, the Mirror Therapy plus Conventional Therapy (MT+CT) group received an additional exercise program to be performed for the non-affected extremity, against the reflecting surface of the mirror and observing the mirror image of the moving limb. Re-assessment of the outcome measure was done after the intervention of 4 weeks. Data analysis showed significant changes in the Fugl Meyer Assessment scores of the CT group (Control) (p=0.02) and MT+CT (Experimental) group (p=0.0001). On analyzing the difference in the mean scores of both the groups, FMA score showed significant changes (p=0.02).

**Keywords:** Mirror therapy, Lower limb, Fugl meyer assessment, Home-based therapy.

### Introduction

Stroke is defined as 'a clinical syndrome characterized by rapidly developing signs of focal or global disturbance of cerebral functions, lasting for more than 24 hours or leading to death, with no apparent causes other than vascular origin'.<sup>1</sup> Each year there are approximately 15 million strokes worldwide, making stroke one of the major causes of high level disability in the home and in the community. In the USA, UK and Australia, stroke is found to be a principle source of burden of care and of long term disability and it has been highlighted that these factors are accentuated and maintained by impaired walking ability.<sup>2</sup> The rehabilitation of impaired lower limb functioning post stroke is a major issue and this is demonstrated by the fact that approximately 30% of patients with chronic stroke have persistent difficulties in independent ambulation.<sup>3</sup>

In 1992, Ramachandran *et al.* introduced the concept of mirror visual feedback (MVF) as a simple non-invasive technique for the treatment of phantom pain and hemiparesis following stroke.<sup>1</sup> Mirror therapy (MT) in its standard form has been proposed as a possible cost effective and simplistic adjunct to established stroke interventions<sup>4</sup> and thus, may have the potential to fit into a more interdisciplinary and up-to-date evidence based approach to stroke rehabilitation.<sup>2</sup> Mirror therapy in stroke involves performing the movements of the non-paretic limb while viewing its mirror reflection superimposed over the unseen paretic limb.<sup>5</sup> This visual feedback can substitute for the missing proprioceptive feedback from the paretic limb.<sup>6</sup> Thus, mirror therapy helps to prevent or reduce the learned non-use of the paretic limb and also enhance neuroplasticity.<sup>1</sup> Mirror Therapy has been proven effective for upper limb function and is practiced in clinical set up.

But there are patients coming to Adult Neuro-physiotherapy department who face difficulty in attending the physiotherapy treatment on daily basis. Hence, an initiative was taken to expose these patients to the newer techniques of neurorehabilitation as a home based treatment program.

### Materials and Methods

Permission to conduct research was taken from the Institutional Ethical Committee.

The participants were assessed for their eligibility by a physiotherapist. The study included 30 patients (15 males, 15 females) with hemiparesis after stroke. Patients who were willing to participate with first episode of hemiplegia (first episode of hemiplegia), Brunnstrom motor recovery stage  $\geq 2$ , MMSE score:  $>25$  were included in the study.

However they were excluded if they had any uncorrected visual and auditory disturbance, were medically unstable or with any acute musculoskeletal involvement of lower limb.

### Outcome measure

Fugl Meyer Assessment of lower extremity was used as an outcome measure which is a reliable and valid tool for assessing the motor recovery in patients following stroke.<sup>7</sup> It is based on Twitchell and Brunnstrom's concept of sequential stages of motor recovery in stroke patients. Scoring of the scale is based on direct observation of the performance. Scale items are scored on the basis of ability to complete the item using a 3-point ordinal scale. In addition, preliminary evidence suggests that the FMA is responsive to change.<sup>8</sup>

**Intervention**

Patients in both the groups underwent patient specific institutional physiotherapy protocol for 6 days/week for a period of 4 weeks. It included trunk strengthening exercises (Fig. 1), upper and lower limb weight bearing exercises (Fig. 2), balance and gait training. (Fig. 3).



**Fig. 1:** Trunk strengthening



**Fig. 2:** Upper limb and lower limb weight bearing exercises



**Fig. 3:** Balance and Gait training exercises

In addition to this, the subjects in the Mirror therapy group received an exercise protocol to be performed by the non affected limb against the reflecting surface of the mirror for 15 minutes in long sitting position with the mirror placed between the two lower extremities. The mirror was held by

the relative towards the paretic side to prevent the paretic limb from being viewed by the subject. For the mirror group, the reflective surface was kept facing the non-paretic limb. The exercises included ankle dorsiflexion-plantarflexion, (Fig. 4) inversion-eversion, (Fig. 5) heel slides with holds (Fig. 6) and hip internal and external rotation with holds (Fig. 7).



**Fig. 4:** Ankle Dorsiflexion-plantarflexion



**Fig. 5:** Inversion- eversion



**Fig. 6:** Heel slides with holds



**Fig. 7:** Hip rotations with holds

Post intervention i.e. at the end of 4 weeks FMA-LE was obtained again.

The baseline characteristics of both the groups are shown in Table 1. There was no significant difference

between both the groups with respect to age, gender, side of paralysis, Brunnstrom's stages of recovery, MMSE and Fugl Meyer Assessment-Lower Extremity.

**Table 1:** Baseline characteristics of both the groups

| Variable                                   | CT group | MT+CT group | p value | Significant(s)/ Non significant(Ns) |
|--|----------|-------------|---------|-------------------------------------|
| Age (years)                                | 50.06    | 50          | 0.9868  | Not significant                     |
| Gender                                     |          |             | 0.7094  | Not significant                     |
| Male:                                      | 10(67%)  | 5(33%)      |         |                                     |
| Female:                                    | 8(53%)   | 7(47%)      |         |                                     |
| Side of paralysis                          |          |             | 0.7144  | Not significant                     |
| Right:                                     | 7(47%)   | 8(53%)      |         |                                     |
| Left:                                      | 9(60%)   | 6(40%)      |         |                                     |
| Brunnstrom stages of motor recovery (Mean) | 3.8      | 3.866       | 0.822   | Not significant                     |
| MMSE (Mean)                                | 27       | 26.9        | 0.84    | Not significant                     |
| FMA (Mean)                                 | 19.4     | 19.5        | 0.943   | Not significant                     |

**Table 2:** Paired t test statistics of the pre and post step test scores of the affected limb in the conventional therapy group

| Conventional Group | Mean | Standard Deviation | P value                    |
|--------------------|------|--------------------|----------------------------|
| FMA Pre            | 19.4 | 2.94               | <b>0.02</b><br>significant |
| FMA Post           | 19.8 | 3.11               |                            |

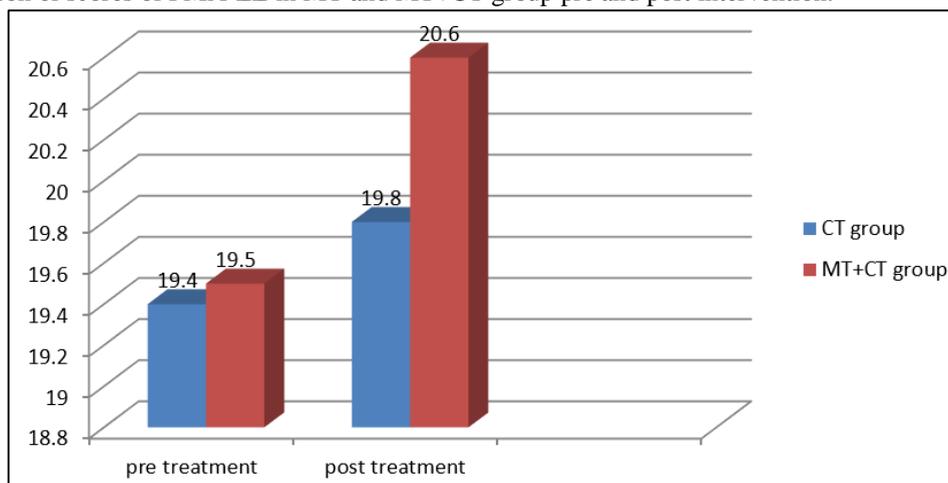
**Table 3:** Paired t test statistics of the pre and post step test scores of the affected limb in the Mirror Therapy group.

| MT+CT group | Mean | Standard Deviation | P value                      |
|-------------|------|--------------------|------------------------------|
| FMA Pre     | 19.5 | 2.10               | <b>0.0001</b><br>Significant |
| FMA Post    | 20.6 | 1.87               |                              |

**Table 4:** Unpaired t test statistics of change in the mean step test scores of conventional therapy v/s mirror therapy group

|     | Mean | Standard Deviation | Mean | Standard Deviation | P value                    |
|-----|------|--------------------|------|--------------------|----------------------------|
| FMA | 0.46 | 0.63               | 1.13 | 0.83               | <b>0.02</b><br>Significant |

**Graph:** Comparison of scores of FMA-LE in MT and MT+CT group pre and post intervention.



## Result

A significant difference was seen in the conventional group when the pre mean FMA-LE score (19.4) was compared with the post mean FMA-LE score (19.8) with a p value of <0.05. A highly significant difference was seen when the pre mean FMA-LE score (19.5) was compared with the post mean FMA-LE score (20.6) of the Mirror Therapy group with a p <0.05. Also, a significant difference was obtained (p<0.05) when change in the mean FMA-LE score of both the groups were compared.

## Discussion

In the present study, a total of 30 subacute stroke patients were selected and divided into control and experimental groups. The Conventional Therapy group subjects underwent patient specific institutional physiotherapy protocol for stroke and the Mirror Therapy group subjects received an additional exercise program to be performed for the lower limb against the reflecting surface of the mirror. The exercises were given in the long sitting position with the back supported, it included ankle dorsiflexion - plantarflexion, inversion-eversion, heel slides with holds and hip abduction and adduction with holds. All the subjects were assessed at the beginning and at the end of 4 weeks of intervention using FMA-LE score.

The results showed an improvement in post intervention FMA-LE scores in both, Conventional Therapy group (0.4) and Mirror Therapy group (1.1) when compared with the pre intervention FMA-LE scores. Also, when the inter group analysis was done, which compared the differences in the mean scores of the CT and MT+CT group, the MT+CT group showed a statistically significant improvement. This is attributable to the exercise program which consisted of exercises to be performed against the reflecting surface of the mirror. The effects are in accord with basic neurophysiological findings, confirming a role of observing mirrored movement in cortical stimulation.

Regarding improvement of motor functions, it has been demonstrated that observation of mirrored distal movements enhances corticospinal excitability, similar to actual movement execution.<sup>9</sup> Also, effects of MT are attributed to "mirror neurons," i.e., neurons in the premotor area of both monkeys and humans that are active during observation of meaningful movements.<sup>10</sup> Also there is a possibility that lesion is not always complete; there may be a residue of mirror neurons that have survived but are dormant or whose activity is inhibited and does not reach threshold. Thus, including mirror therapy as a part of rehabilitation can help stimulate these dormant neurons by providing the visual input to activate them.<sup>11</sup>

The improvement can also be attributed to mechanism of neuroplasticity. It involves modification of cortical representation, improvement in the connectivity with individual neurons and non-synaptic transmission. Also, repetitive practice act on the pre-existing patterns of connections to strengthen their effectiveness.<sup>12</sup>

Also, the visual feedback can substitute for the missing proprioceptive feedback from the paretic limb.<sup>9</sup> Thus, mirror

therapy helps to prevent or reduce the learned non-use of the paretic limb and also enhance neuroplasticity.<sup>9</sup>

Garry et al performed transcranial magnetic stimulation during mirror illusions in healthy subjects and found the increased excitability of primary motor cortex (M1) of the hand behind the mirror.<sup>13</sup> Mirror neurons are bimodal visuomotor neurons that are active during action observation, mental stimulation (imagery), and action execution.<sup>13</sup>

## Conclusion

Both, CT group and MT+CT group showed significant improvement in FMA score. But in the intergroup analysis, MT+CT was significantly better than CT group. Hence, we conclude that incorporating mirror therapy as an adjunct to conventional therapy may be beneficial in enhancing motor recovery as a home based program.

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## Conflict of Interest

None.

## References

1. Mohan U. Effectiveness of mirror therapy on lower extremity motor recovery, balance and mobility in patients with acute stroke: a randomized sham-controlled pilot trial. *Ann Indian Acad Neurol.* 2013;16(4):634.
2. Broderick P, Horgan F, Blake C, Ehrensberger M, Simpson D, Monaghan K. Mirror therapy for improving lower limb motor function and mobility after stroke: A systematic review and meta-analysis. *Gait Posture.* 2018;63:208-20.
3. Langhorne P, Coupar F, Pollock A. Motor recovery after stroke: a systematic review. *Lancet Neurol.* 2009;8(8):741-54.
4. Thieme H, Mehrholz J, Pohl M, Behrens J, Dohle C. Mirror therapy for improving motor function after stroke. *Cochrane Database Syst Rev.* 2012;(3):CD008449.
5. Sütbeyaz S, Yavuzer G, Sezer N, Koseoglu BF. Mirror therapy enhances lower-extremity motor recovery and motor functioning after stroke: A randomized controlled trial. *Arch Phys Med Rehabil.* 2007;88:555-9.
6. Yavuzer G, Selles R, Sezer N, Sütbeyaz S, Bussmann JB, Köseoğlu F, et al. Mirror therapy improves hand function in subacute stroke: A randomized controlled trial. *Arch Phys Med Rehabil.* 2008;89:393-8.
7. Sanford J, Moreland J, Swanson LR, Stratford PW, Gowland C. Reliability of the Fugl-Meyer assessment for testing motor performance in patients following stroke. *Phys Ther.* 1993;73(7):447-54.
8. van der Lee JH, Beckerman H, Lankhorst GJ, Bouter LM. The responsiveness of the Action Research Arm test and the Fugl-Meyer Assessment scale in chronic stroke patients. *J Rehabil Med.* 2001;33(3):110-3.
9. Dohle C, Püllen J, Nakaten A, Küst J, Rietz C, Karbe H. Mirror therapy promotes recovery from severe hemiparesis: a

- randomized controlled trial. *Neurorehabil Neural Repair*. 2009;23(3):209-17.
10. Fukumura K, Sugawara K, Tanabe S, Ushiba J, Tomita Y. Influence of mirror therapy on human motor cortex. *Int J Neurosci*. 2007;117(7):1039-48.
  11. Ramachandran VS, Altschuler EL. The use of visual feedback, in particular mirror visual feedback, in restoring brain function. *Brain*. 2009:awp135.
  12. Carr JH, Shepherd RB. Neurological Rehabilitation: Optimizing motor performance. 2<sup>nd</sup> ed. Indian Reprint ISBN: 978-0-7020-4468-7. First Reprinted in India 2011.
  13. Garry MI, Loftus A, Summers JJ. Mirror, mirror on the wall: viewing a mirror reflection of unilateral hand movements facilitates ipsilateral M1 excitability. *Exp Brain Res*. 2005;163(1):118-22.

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